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SOME OUTSTANDING ACCOMPLISHMENTS OF THE BUREAU OF STANDARDS IN 1925

1. The Application of Chromium Plating To Printing Plates

A few years ago the Bureau of Standards in cooperation with the Bureau of Engraving and Printing developed an electrolytic process for the reproduction of engraved or "intaglio" plates, such as are used for printing currency and securities. The plates produced by this process which has been in successful use since that time, have a nickel printing surface, backed up by successive layers of copper and nickel.

In plate printing, the metal surface is rubbed with coarse cloth before each impression to remove the ink from the plane surface and to leave ink only in the engraved lines. This process involves severe abrasion, and hence the nickel plates do not last as long as the case hardened steel plates, which had been used formerly exclusively. In order to increase the hardness of the surface of the electrolytic plates, the application of chromium plating was considered, because chromium is the hardest metal known.

A process was developed by which about .0002" of chromium is deposited upon the nickel surface of an otherwise finished electrolytic plate. The results with about 1000 such plates show that the impressions are even better than from the originals, and that they yield several times as many impressions as the nickel faced or case-hardened steel plates. It is also possible to deposit the chromium on steel plates which have not been case-hardened and to secure from them greater service than from case-hardened plates. It is too early to estimate the average probable life of the chromium faced plates, but from present indications their use will ultimately result in greater efficiency and enlarged output from the Bureau of Engraving and Printing.

These results indicate that chromium plating may be of great value for other purposes, especially where extreme hardness is required. In some cases it may replace the more troublesome and more expensive case hardening process. Other properties of chromium plating which may prove useful are its high lustre and reflecting power and its resistance to tarnish and oxidation, also toward certain chemical reagents.

2. A Method of Determining the Cause of Crazing and Fishscaling

The surface of a great many clay products is coated with a glaze or colored coating material in order to attain a high artistic effect and other properties such as low abrasion and absorption coefficients. These coatings are found on terra cotta exterior work, tile inside walls, on all kinds of table ware and in many other places. It frequently happens that this outside coating crazes or chips off in the so-called fish scale manner. This takes place as a result of temperature changes. If the coefficient of expansion of the coating material differs considerably from that of the body, the stresses developed by the expansion differences cause cracking and in some cases a complete falling away of the glaze from its body.

Comparative investigations on the expansion of the glaze when in the form of a rod and when in the form of a chip as broken from the body material revealed that the expansion coefficient was different by the two methods, and further that the latter method gave the values which determine whether or not the glaze will craze due to temperature changes.

3. Photographing the Interior of a Rifle Barrel

The interior of a rifle barrel is gradually worn away by the action of the hot gases and high pressures developed during firing. This process is termed erosion, and careful studies are made of the manner in which different barrels erode in order to improve the durability of guns used by the army and navy. The wearing away of the interior surface of a large gun is studied by means of wax impressions taken of the bore. With the service rifle or machine gun barrel this method is impracticable, because the diameter is only about 3/10 of an inch, and it has been the custom to split the barrel lengthwise for an examination.

A camera has been developed by the Bureau of Standards which permits the bore to be examined without mutilation of the barrel. A long periscope is inserted in the bore and a small incandescent light at the end of the periscope provides the illumination. The image of a small portion of the bore is brought out by the periscope and received on a motion picture film. The barrel is automatically moved so that different portions of the bore are photographed in succession. At the same time the motion picture film is moved in such a manner that the different pictures fit together and one secures a long picture on the film which shows a strip of barrel extending along its entire length and including about a sixth of the circumference. Six such pictures show the entire interior surface of the bore.

4. A new Method for Controlling the Quenching of Steel

The Bureau has developed a new method for investigating the hardening of steel by quenching, an essential operation in the production of modern, high strength, heat treated steels. In this work an Einthoven string galvanometer, an apparatus similar to the electro-cardiograph used by physicians to study the heart, is used to record the temperature changes during the few seconds elapsing in the quenching of a small piece of steel.

Thus we can tell what is going on in that brief interval, and using the same sort of steel, different quenching media can be studied, or using the same quenching medium, the behavior of different steels or different sized pieces of the same steel can be determined.

This method has brought added insight into the fundamental laws affecting the hardening operation. Results given in a paper from the laboratory published in September, 1924, were immediately put to use by a large commercial organization, a representative of which reported in a paper presented in January, 1925 that, using as a basis the data shown in the Bureau of Standards paper, they had altered their quenching practice on a new type of product and that the new method is both easier to control and more uniform in practical results than the former longer and more expensive method.

This method of attack has been applied to other phases of the quenching problem and a report made before the American Society for Steel Trating in September 1925, showing how, with a minimum of experimental work, it can be predicted what sizes, in simple shapes, of a given steel will harden throughout in quenching in a given medium. The comment on this work by representatives of the steel industry indicatesthat this will be as useful as the previous work proved to be.

5. Sound Insulating Properties of Partition Walls.

During the last year sound transmission measurements were made on thirty four panels of partition wall construction with the aid of the Gypsum Industries, Inc., and the National Lime Association. It was found that the sound characteristics of a wall vary considerably during the seasoning period of two or three months. The experiments were carried out with such representative frequencies as are common in the human voice. The studding material proved to be of more consequence than the composition of the plastering materials that were used.

6. The Control of Refractivity and Density of Optical Glass

In the manufacture of optical glass it may frequently happen that the refractivity and density may be just outside the limits of purchase

on manufacturing specifications, even when the composition is carefully controlled. Recent researches at the Bureau have not only shown that these properties may be altered by heat treatment after the glass is made but they also define the procedure to be used in order to alter the refractivity and density in the direction desired. With a soda-lime or medium flint glass the refractivity may be changed as much as 2 in the third decimal place by annealing at 523° C where the effective annealing temperature of glass originally was at 404°C. With this new information it will be possible for the manufacturer to simplify his stocks and also it will simplify the work of the manufacturer of optical goods.

7. Piezoelectric Frequency Standard

The research on the uses of piezoelectric oscillators as radio frequency standards has been in progress for over a year and noteworthy useful applications have developed. A piece of quartz crystal 1 or 2 inches long has a natural mechanical frequency of the same order as the frequency of currents used in radio communications. With the natural mechanical vibrations there is an accompanying electromotive-force generated of the same frequencies. This furnishes the basis for an exceptionally valuable portable radio frequency standard. It has been used along with other methods for making the frequency standard of the Bureau available at distant places and has been found to be the best of such methods, primarily because the frequency is a function of the dimensions of a quartz plate which can not change in shipment. The Bureau has designed and supervised the building of a number of frequency meters (or wave meters) according to this principle for the use of the radio inspectors of the Bureau of Navigation.

8. A Standard State Zoning Enabling Act

The Division of Building and Housing has for several years been working toward the establishment of a standard State zoning enabling act under which municipalities may adopt zoning regulations. In September 1921 only 48 cities and towns with less than 11,000,000 inhabitants had adopted zoning regulations. The time was ripe, therefore, for a standard act which would make it practicable for cities to arrive at neighborly agreements as to the use of land. The standard zoning enabling act which the Bureau has promulgated is drawn up so as to permit zoning to be undertaken under it without injustice and without violating property rights. This work is being received with great favor. Already seventeen states have adopted this standard act.

9. Thermal Expansivity of Glazes

Glazed ware, which consists of a body of clay (terra cotta, porcelain, whiteware) covered with a thin vitreous layer of a material of

differing composition, is used extensively in the building trades as well as for dishes, sanitary ware and objects of art. The large percentage of failure of this sort of ware due to cracking of the glaze is a serious defect and one responsible for enormous losses to the ceramic industry as well as to builders and other users. That the ceramic industry is alive to this condition is evidenced by the fact that one association of manufacturers is spending over ten thousand dollars a year on research work in hopes of correcting it.

Since a glaze is by its nature brittle and is only a few tenths of a millimeter thick, the only logical way to prevent its rupture is to reduce the stresses below its yield point. The stresses introduced into the ware by a differing rate of contraction between body and glaze during the last cooling in the furnace are enough to rupture the glaze at once or to reduce its resistance to subsequent stresses. Since the thermal expansions of both glazes and bodies can be changed by the addition of other constituents, it would seem to be a simple matter to match the two materials provided their physical properties were known. The trouble has been that the methods of obtaining the thermal expansivities of the glazes have been so far in error as to mislead rather than help in a solution of the difficulty. The Bureau has developed a method for measuring this property of a glaze as it exists under the conditions of manufacture which agrees in all observed cases with the actual condition of the glaze. Measurements on samples produced according to the old method gave diametrically opposite and misleading indications. The methods developed by the Bureau if used in conjunction with proper factory control should enable the manufacturer to eliminate this cause of failure.

10. Directory of Specifications

The National Directory of Commodity Specifications has been prepared in recognition of the need for an authoritative directory of the specifications that are in actual use with the names of the organizations that have formulated or are sponsoring these specifications. The work of compilation has been brought to a successful conclusion by reason of the very helpful and thorough cooperation of the numerous organizations vitally interested in specifications.

Information regarding the best known specifications for more than 6000 commodities is given in convenient form in the Directory which contains a classified list of over 27,000 specifications for these commodities formulated not only by the public purchasing agencies, but also by the public utilities, trade associations, and technical societies having national recognition.

More and more it is being appreciated that considerable economy can be secured in the purchase of commodities by the use of specifications. The Directory cannot but give considerable stimulus to the popularizing of the use of specifications, and its widespread distribution will be

effective in encouraging the maximum possible number of purchasing agents to make use of the best known specifications, including those of the Federal Specifications Board, thereby inducing the maximum possible number of producers to manufacture commodities in accordance with the nationally recognized specifications, resulting in the broadening of the field of supply and the lowering of the production cost which accompanies the introduction of quantity production.

The economic significance of the whole undertaking is quite evident, and the magnitude of the possible savings can be visualized without difficulty. It is known that the Federal Government spends about one-fourth billion dollars annually for supplies and equipment, and it is estimated that the various local governments throughout the country spend about three-fourths billion dollars annually for such commodities. These two groups alone make purchases to the extent of a billion dollars. Public purchasers as a whole are desirous of utilizing well-recognized specifications to the maximum possible extent, and the Directory will give them the exact information needed for this purpose. The Directory will likewise point the way for the purchasers of numerous public utilities and industrial organizations that are, or should be, making use of specifications, so that its influence will be felt throughout all branches of industry. It cannot but assist in the elimination of waste in the manufacture and distribution of the fifty billion dollars worth of products turned out annually by the factories of this country.

11. Cotton and Jute Cement Sacks

In cooperation with the Portland Cement Association the Bureau carried on a series of investigations to determine the relative merits of several types of jute burlap sacks in comparison with the cotton sacks in common use. The Portland cement industry spends about $13,000,000 annually for cotton osnaburg sacks to be used as containers for Portland cement.

The physical tests made included breaking strength, thread count, length, width, stretch, and failure from dropping or rough handling. Finally practical tests were made on the sacks which made the best showing, by filling the sacks with hot freshly ground cement after which they were given a humidity test by exposing the filled bags to various atmospheric conditions including excessively damp conditions.

This investigation has already demonstrated that a cement sack can be made of jute burlap and be superior in those properties that seem most essential. If the cement industry takes advantage of this investigation, the cost of containers will be reduced by about $3,000,000 annually.

12. Simplification of Building Materials

Since the beginning of time, one of the essentials of man's existence has been shelter. Hence, any action which could be promoted to

affect the price he pays for shelter is of direct influence on his health, welfare, and standards of living.

One of the efforts of the Department of Commerce to eliminate waste in industry has been through the Division of Simplified Practice of the Bureau of Standards. This Division, cooperating with industry in reducing or weeding out the unnecessary number of sizes of any given article and the elimination of useless variety of commodities in everyday use, has directed much of its effort toward the field of building and construction. The Division, providing a neutral and friendly meeting ground for the joint consideration of existing variety, for the analysis of demand and for group action of eliminations of mutual benefit to producer, distributor and user, has had a part in notable progress in this field.

During the year ending July 1, 1925, group conferences held under the auspices of the Division brought about the reduction of excess variety in softwood lumber, terne plate, steel reinforcing bars, eaves trough and conductor pipe, hot water storage tanks, slate for roofing and plumbing purposes, builders' hardware, brass lavatory and sink traps, and concrete building units. It had also cooperated with industrial groups in initiating simplification programs in other fields entering into construction, notably, sand lime brick, electric lamp sizes, window sash and door sizes and layouts, brass valves and fittings, paints and varnishes and paint and varnish brushes.

Outstanding among the simplifications accomplished, from the viewpoint of the volume of business, the extent of consumer interest and of its effect on home building, was that of the soft wood lumber group. Adopting grading rules, standards of nomenclature and other provisions, the conference eliminated 60% of the soft wood yard lumber items. This was a long step forward for the protection of the consumer, the provision of better values and wiser purchase of materials. Savings from this action are estimated at $250,000,000 annually. Similarly a reduction of 71% in recognized finishes and 26% in catalogued items of builders' hardware is estimated to mean a saving of $10,000,000 a year; while a total of $4,500,000 is estimated to be saved annually to producers and distributors from reductions in cross section areas of steel reinforcing bars. Adoption of uniform sizes and capacities and standard pipe tappings for hot water storage tanks assures the home builder of savings in time of installation and ease of replacement. The advantage holds good for the simplifications in brass traps and plumbing slate; while simplification of concrete units gives the home builder the choice of an added material. Eliminations of unsuitable weights of terne plate for roofing and of meaningless variations in slate roofing place two roofing materials on a more even footing for the home builders consideration.

These are further steps in rounding out a program which already included simplifications of sizes of face and common brick, hollow

building tile, metal lath, range boilers and to help the home builder secure better values for the funds he has to invest in what is often the greatest purchase of his life time.

13. Automobile Headlighting

The lighting of automobiles is of direct interest to more than 15,000,000 users of automobiles, and to many millions of pedestrians. Much discussion has been heard by everyone condemning the present situation, but a long campaign of education of the individual motorist to keep his own lighting equipment in adjustment is necessary before much improvement in the general situation can be expected. The Bureau of Standards has contributed notably to this campaign of educating the motorist, the dealer, the service station, and even the motor car manufacturer by issuing a publication entitled "Motor Vehicle Headlighting", by making tests on headlighting devices for State motor vehicle administrators, by advising State testing laboratories as to testing methods, by furnishing standard lamps, and by advising manufacturers of headlighting equipment. The State of Oregon has designated the Bureau of Standards as its special testing agency. California by law requires its motor vehicle administrators to approve devices whose manufacturer presents a certificate of test from the Bureau, the proposed uniform motor vehicle act for general adoption makes the Bureau the testing authority and the Eastern conference of motor vehicle administrators, comprising a dozen or more Eastern States has requested the Bureau to make the tests prior to State approval of headlighting devices. Other States and conferences of States are expected to join in this effort for common regulations. The accomplishment that is noteworthy is in the focusing of the public attention on a single testing and standardizing agency.

14. Cooperation with Industry

Immediately following the war the growing demands for highly trained technical men to meet the increasing demand for industrial research, threatened the Bureau with a depletion of its staff and thereby a curtailment of its research activities. This situation led to the establishment by the Bureau of a Research Associate Plan, whereby a manufacturer or association of manufacturers might place a graduate physicist, chemist or engineer, at the Bureau for a period of one or more years to carry on investigation in some particular line.

This plan has proved valuable, both in the training of additional research specialists by association with the Bureau staff and in maintaining the research output of the Bureau in lines which are of special industrial importance.

The Bureau of Standards, with an eye to the public welfare, cooperates wherever feasible with the industries in the development and promotion of

higher standards and minimum production waste in the commodities of commerce. In effect, therefore, the research associate plan is a plan for cooperative investigation to such ends. The work undertaken under this plan is such that it would be done by the Bureau alone if its funds were sufficient. The cooperative method may be, however, somewhat more certain of practical results and these results thereby likely of quicker adoption. Cooperative work is not encouraged except in fields where the Bureau has rather complete equipment and highly specialized personnel to give advice and assistance.

After deciding that the results to be obtained will be for the general welfare of the industry and the public, and an agreement has been reached with the industry, a candidate is sought for the position of research associate. In some cases the Bureau takes the initiative in this search, in others the employer. In either case both parties agree upon the man and his qualifications - usually a graduate in technical lines with the equivalent of one or more advanced collegiate degrees.

Upon appointment, the research associate is assigned to one of the divisions, his status becoming that of a Bureau of Standards employee, subject to the same rules and regulations and with the rights and privileges, including the privileges of advice and consultation. This includes the working periods, accrued and sick leave, previous notice of travel, etc. The Bureau does not, however, handle his pay.

Each research undertaken by the associate is authorized in the customary way by the Director, at the request of the section and division to which the research associate is assigned, previous agreement with the supporting industry having been arrived at.

It is estimated that American industries are spending nearly a half million dollars annually on these cooperative projects.